PQSENSING

COLLABORATION INVITATION · UNIVERSITY & METROLOGY LABS

PATENT PENDING · NSL + DPI

Validation Sprint: Noise-Stationary Locking on a tabletop Mach–Zehnder

A lean, classical first experiment to test whether locking to the measurement-noise minimum beats locking to the fringe.

The idea, plainly: conventional locks hold an interferometer at an optical setpoint (a fringe or power extremum). **Noise-Stationary Locking (NSL)** instead servos to where the *normalized measurement-band noise* is stationary — the quietest useful operating point. When structured noise is misaligned with the fringe, those two points differ, and NSL keeps the instrument where its numbers are actually best. The objective: $V_{norm}(\delta) = N_{band}(\delta) / P(\delta)^k$, locked at $dV_{norm}/d\delta \to 0$.

THE EXPERIMENT

Build a classical Mach–Zehnder (no squeezed source required). Sweep the operating point and map $P(\delta)$, $N_{band}(\delta)$, and $V_{norm}(\delta)$. Inject repeatable jitter, then compare a conventional power/PDH lock against NSL under the same disturbance.

WHAT THE LAB PROVIDES

- ☐ Optical bench or Mach–Zehnder / cavity test setup
- ☐ Photodetector or balanced readout
- ☐ PZT or phase actuator
- ☐ DAQ / controller (Moku or Red Pitaya class is fine)
- ☐ Guidance on a defensible validation protocol

WHAT THE PARTNER GETS

- ☐ A focused, publishable applied-optics / control project
- ☐ Student-useful data and a clean measurement task
- ☐ Early visibility into patent-pending, Kansas-origin photonics IP
- ☐ A clear sponsored-research or prototype path if the traces hold up

SUCCESS METRICS (TARGETS, NOT GUARANTEES)

Setpoint separation	V_{norm} minimum differs from the power extremum in ≥1 injected-noise regime.
Noise reduction	≥6 dB vs a power lock under controlled jitter (stretch: 10–20 dB).
Slope-null convergence	$\lvert dV_{norm}/d\delta \rvert$ driven toward zero above a power floor.
Reacquisition	≥5 recoveries after intentional mislock.
DPI (optional)	Recover a known dark-port code by matched filtering.

WHY IT'S LOW-RISK

Classical optics only, standard lab instruments, a firmware layer that runs *alongside* your existing lock — not a replacement. The first milestone is designed to prove or kill the control thesis cleanly, with raw traces, plots, and reproducible analysis as the deliverable.

$10K minimum data sprint

Also runnable as a sponsored test, student project, supervised lab exercise, or vendor application note.

Next step: a 20–30 minute feasibility call to scope it to your bench.

Peterson Quantum Sensing LLC · Hugoton, Kansas · NSL & DPI patent pending

Jon Peterson · mroweitall@gmail.com · 620-518-3686 · www.pqsensing.com